SUPPLEMENT.

The Mining Journal,

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FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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Original Correspondence.

THE EXTENSION OF OUR COAL FIELDS.

COAL—THE MAINSPRING OF OUR NATIONAL PROSPERITY: ITS PERMANENT AND ECONOMIC SUPPLY OF PARAMOUNT IMPORTANCE; AND ON THE PROBABLE EXTENSION, BY GEOLOGIC INDUCTION, OF THE CENTRAL ENGLISH COAL FIELDS BENEATH THE SECONDARY FORMATIONS.

Sir,—As a nation we may unquestionably be said to constitute a monument of unrivalled constitutional greatness and splendour—of civilisation and freedom, alike the admiration and the envy of beholders. Raising its stately proportions at the head of the great European confederation, it appears to the enslaved, and the unenlightened of all the earth, as a beacon of hope, and a radiant pharos, towards which millions of straining eyes are turned for liberty and enlightening advancement; and it is also no less true that this admirable fabric is not only virtually founded on the well-stored coal formations of the British isles, but that the material elements of its construction were mainly derived from their pregnant and precious product.

It behoves us, then, as we value our pre-eminent position, and our Heaven-entrusted mission—nay, our very existence as a great and independent community—to look well to the foundation rock of our abounding prosperity.

As our various national resources have continued to increase in vigour and magnitude, and industrial enterprise has daily become more and more largely developed, so, in a perpetually increasing ratio, has been the drain, so to speak, on the precious deposits of our great carboniferous store-houses—in fact, the consumption of coal at the present period is altogether unprecedented. Not less than 37,000,000 tons are now annually raised to meet the demand in various quarters! The value of this vast mass of the mineral extracted from the bowels of the earth by the labours of about 160,000 persons is at the pit's mouth little less than 20,000,000*l.*, at the places of consumption, including expenses of transport and other charges, probably not less than 20,000,000*l.* The capital employed in the trade exceeds 10,000,000*l.* London alone consumes upwards of 3½ millions of tons annually—about half a million of which are now brought by the Great Northern Railway; and as a proof of the rapidly-increasing consumption, a metropolitan return, which has recently been issued, shows that, in 1853, there were 3,745,345 tons brought into the port of London, against 3,490,963 tons of the preceding year. In 1850, our coasting vessels conveyed upwards of 9,360,000 tons to various ports of the United Kingdom; and 3,350,000 tons were exported to foreign countries and the British possessions. Of these, France took 612,545 tons; Holland, 159,953 tons; Prussia, 186,528 tons; and Russia, 235,198 tons. Our ocean steamers now require very large supplies indeed; and it is calculated that 30,000 tons will be required for the use of the Baltic and Mediterranean fleets. The consumption by our manufacturing establishments is immense; and as one isolated proof of the rapidity and extent of the increase, I may mention the fact that, in the year ending Oct. last, 113 new mills have been built in Lancashire; and the gross increase in the year of steam power has been 3894 horses, requiring 15,600 additional hands!

About 400 iron-furnaces of Great Britain consume annually 10,000,000 tons of coal, and 7,000,000 tons of ironstone, in order to produce 2,500,000 tons of pig-iron, of the value of upwards of 8,000,000*l.*; and we must not be unmindful that these great smelting establishments, in order to meet the vast and growing demand for iron rails, houses, churches, ships, &c., are now constantly augmenting in number, which, with other demands, it is obvious to particularise, will also tend to increase immeasurably the present consumption of coal. In short, astounding as are the statistical facts just enumerated, they assume a still more transcendent and portentous importance, when viewed in relation to the future, especially as regards the far-spreading mechanical energies, commercial movements, and spirit of universal enterprise, characterising this great and populous country. To develope, to conservate, to investigate with jealous care this grand element of internal strength and prosperity—the *primum mobile* of our multitudinous and world-wide progressions—cannot but be considered as sacred duties by every man possessed of a single spark of patriotism in his breast. Far be it from me to exhibit any unnecessary prominence in sounding the tocsin of alarm; but it were impossible for any one at all conversant with the existing facts and prospective bearings of this subject not to entertain some serious forebodings as to the permanent capacities of our English coal fields. The many and laborious calculations, which, in order to arrive at some conclusive information on this vital point, have been entered into by men well versed in the matter, have resulted in but very discouraging declarations. Mr. Bakewell, than whom more acute and accurate observer, or a sounder practical geologist never explored the field, in descanting on the bituminous deposits of the northern fields, remarks, that the period is not very remote when the coal districts which at present supply the metropolis with fuel, will cease to supply any more. From data derived from the correctly-ascertained numerical extent of the coal beds of Northumberland and Durham, it has been calculated that the coal in these counties will last but 360 years; for though there are as many as 40 distinct seams of coal in this field, but 18 of them are considered workable, or sufficiently thick to remunerate by their produce.

Another eminent authority, Mr. Taylor, observes, that notwithstanding the enormous annual produce of the northern field, it is a very moderate calculation of its resources, to suppose that the present supply can be kept through the next four centuries. The trade has been in existence for upwards of six centuries. Mr. Bailey, in his *Survey of Durham*, states, "one-third of the coal being already got, the coal districts will be exhausted in 200 years. One would imagine that such gloomy conclusions would induce the utmost care to be taken in economising every particle of the mineral; yet the very reverse would appear to rule; for Mr. Hedley, in his *Treatise on Coal Mines*, states the waste of small coal at the pit's mouth to be one-fourth of the whole. The waste in the mines is computed to be one-third. These are facts, which alone loudly call for the support of legislative interference.

As regards all the other known English coal fields, Mr. Bakewell, after entering into some elaborate disquisitions on the capabilities and demands of each, concludes by remarking that we may thus anticipate a period not very remote when all the English mines of coal and ironstone will be exhausted; and, continues he, "were we disposed to indulge in gloomy forebodings, like the ingenious authoress of the *Last Man*, we might draw a melancholy picture of our starving and declining population, and describe the manufacturing patriarch, like the late venerable Richard Reynolds, living to see the last expiring English furnace, before he emigrated to other regions."

It is true, however, that from this discouraging picture we may, for consolation, turn to the 100 square miles of coal providentially stored in South Wales; but the supplies in reserve, even in this noble field, do not in the least detract from the paramount importance of forthwith availing ourselves of every possible information, and means for the discovery and development of new deposits of the precious mineral; and which, as I have heretofore endeavoured to demonstrate, do certainly exist at accessible depths beneath vast areas of the secondary formations. If it were truly said, that the man who caused two blades of grass to grow where only one blade could grow before was a benefactor to his kind, surely he who can render himself at all instrumental in the realisations of such general advantages and incalculable blessings, which must inevitably emanate from such discoveries as those just adverted to, will right well deserve the approbation of the community.

Nevertheless, strange as it may appear to the initiated, a disposition is very commonly evinced by those who rejoice in the popular acknowledgment of their geologic lore to condemn, on the grounds of their own scientific views or acquisitions, all attempts at searching enquiries or actual operations that may be adventured upon with a view to the discovery of coal in any of the unexplored tracts of central or more southern England. It would appear, however, that the schoolmaster is now abroad to some purpose; for the gentlemen of the pick, as we have so recently witnessed in your valuable Journal, have dared to menace these gentlemen of the pen with a southern extension of their own legitimate carboniferous territories, also on grounds *geological!* Henceforth, therefore—

> 'Tween the pens and the picks the battle will rage,
> Each aiming at victory's palm;
> And if declared in behalf of the closeted sage,
> It can do the poor pitman no harm.
> But should the knights of the pick, by one lusty stroke,
> Decide as the "practical" wills,
> Then sages may pack up their fame—'tis no joke—
> And "cut off like bricks" to the hills!

It may be unnecessary to observe, that in this little *jeu d'esprit* there is more of truth than elegance; and it may be no less so to intimate, that whilst the scientific *veto* complained of stays the hand of the experimenter, so long, it is obvious, will the adverse opinions broached on this pregnant subject remain inviolate; and yet this great problem, after all, can alone be solved by some adequate and well-directed practical efforts.

Now, I would proceed to examine, with all possible brevity, how far the discouragers of these most important enterprises are, on geological principles, justified in their avowed opinions. Comprehensively viewed, the grand theatre of our present investigations is, in fact, the area lying between the more northern primary and transition districts of England, and the German ranges. Were all the sedimentary deposits now occupying —*stratum super stratum*—the intervening space to be swept away down to the coal measures, we should behold a profound expansive valley, or basin, with, doubtless, a most unevenly disposed contour of surface. Certain of our own known coal tracts, with those of the Hainault, Tournay, and Valenciennes, would, we know, figure there, and from analogy may naturally infer a junction of them, or, at all events, a vast extension of the respective fields beyond their as yet ascertained limits. And should even the whole of the above-mentioned area be occupied by the coal formation, it is but a mere point as compared with the extent of some coal-fields, and especially that of the Mississippi, which alone would cover half of Europe, having an extent of 900,000 square miles, or 1500 miles in length by 600 miles in breadth.

Reverting now to the area in question, as it is actually characterised by its existing geological features, and commencing with the southern extremity (say) of the Warwickshire coal field, with a view to direct our investigatory steps towards the metropolis, or to the south-east. We pass over, at right angles, in ascending succession, a series of formations, chiefly trending in narrow zones through the country in a north-east and south-west direction—namely, the new red sandstone, lias, and oolites, all with a gentle inclination, disappearing in turn beneath each other, until we reach the cretaceous deposits; and continuing onwards over these (and the tertiary) we ultimately arrive at their southern escarpments in north-eastern France and Belgium, where we find them (the chalk strata) actually reposing immediately on the coal formations of the extensive basin of the Hainault, &c.!—all, the great sedimentary deposits which we have found interposing geologically between the coal fields of central England and its chalk ranges, having here entirely disappeared from their assigned geological position; in other words, have respectively thinned out, and it is impossible, in our present state of information, to say whereabouts in the line of march, above intimated, the first-cited secondary formations come to their southern termination—after their respective disappearance to the south-east—or what their thickness where present; and hence the absurdity of assuming even their subexistence, or of defining their vertical dimensions, in any such concealed positions, ere actually tested by some effective practical operations.

Most erroneous conclusions are also commonly arrived at, from calculating the thicknesses of these great secondary zones, from the appearances of their basset edges at surface. These very often occupy considerable tracts of country, and having but a very slight general inclination, it is next to impossible, from such data, to assign a given thickness to any extent of any one of these formations; and hence the very great discrepancies in the estimates of their individual or aggregate thickness, as given by various geological writers. Ideal geological sections are at best but very faithless representations of expansive stratified deposits as they occur in nature. Really some of our eminent geologists would seem to profess to be imbued with a sort of intuitive knowledge of the exact character and contents of every stony layer with which they have encircled the globe, and expect as much uniformity in the distribution of detritus as in the leaves of their own volumes! Verily, geological spectacles do very often enable the gifted wearers to see some twenty or thirty miles into the nether regions—what an invaluable acquisition would they be to the miner!

Whatsoever may be the notions entertained of the extent and uniformity of our great secondary formations, from their appearances at surface, there can be no difficulty in showing that their deposition as regards individual members and groups has, in reality, been extremely arbitrary. Mr. Hopkins, in touching on this matter, in his original and philosophical treatise on *Geology and Terrestrial Magnetism*, justly remarks, that a great number of beds in the sedimentary formations are always absent, and their respective development varies considerably in different localities. England, says he, contains almost all the series, from the south frigid to the north temperate zones, but not piled on one another, as described in the usual geological sections, but overlapping at the edges, at different extremities of each other, thus showing, that although some parts were constantly under the sea, receiving new deposits, they were not always the same, but alternately changing, according to circumstances. "And," he adds, "by reading some geological works, it may be supposed that the earth was once actually covered by all the variety of beds, like the concentric coats of an onion; but such an idea is very erroneous, because it is abundantly evident that the depositions were extremely local."

The actual investigations of Mr. Bakewell induced him to record similar opinions. He says, "It may be frequently observed that particular beds which occur in one part of a formation, and are considerably developed, cannot be traced even into an adjacent district, or they vary so much in thickness and mineral characters as scarcely to be recognised." "If," he continues, "we take an extensive formation, like the oolites, as an example, it is not possible to assign any one part of the range as affording a correct type of all the series in distant, or even in neighbouring, parts of the range, though we may trace a general resemblance in all the principal beds."

Then, again, the formations in question must respectively have been subjected to the tremendous effects of denudation, not only during the epoch of their deposition, and before they were covered by the succeeding one, but also at their outcrops, repeatedly, since those distant periods. Vast and numberless are the examples of this transposing power, even in our own island. The Wealden and cretaceous groups especially, throughout, teem with evidences of extensive denudation. The lias and oolites, in all probability, once covered vastly more extensive areas herein, than they occupy at the present. Outlyers of these formations are to be seen in the north of Ireland, the Hebrides, and northern Scotland. The old red sandstone, which now exists in detached masses in the latter country, it is believed once covered nearly the whole of its surface. Mr. Hugh Miller, whose work on this formation is so highly appreciated by scientific men, tells us, that by the tremendous power of denudation, a deposition of the old red sandstone, full 3000 feet thick, in the western districts of Ross, has been swept away, and the gneiss rocks on which it rested laid bare. The same astute observer assures us that denudation to an extent equally great has taken place in the Scotch coal field. "Lunardi," says he, "in his balloon, never reached the point, high over Edinburgh, at which, save for the waste of ocean, the coal seams would at this moment have lain!" After the contemplation of effects so universal and gigantic as these (and so adverse to all ideas of great continuous uniformity of existing deposits), it may well be asked—

> "Who was it scoop'd these stony waves?
> Who scalp'd the brows of old Cairngorm?
> And dug these ever yawning caves?
> 'Twas I, the Spirit of the storm."

I may next, and with no less confidence, advert to the elevating forces which have so extensively acted on the sedimentary strata, both during and subsequent to their deposition, and have, in all probability, very efficiently operated in bringing up the coal measures of our great Anglo-Belgic basin, or series of basins. It does not come within my province to stop here to enquire into the elemental character of the agencies which Nature employs to produce such stupendous phenomena. To some are ascribed a sudden, and to others a gradual motion. Mr. Hopkins has very ably and ingeniously employed the doctrine of magnetic currents to the oscillations of the earth's surface. Certain it is, that a dynamic power has slowly elevated vast tracts of country, as exemplified in the gradual rising of the shores of the Gulf of Bothnia and the northern coast of Sweden and Denmark. Very remarkable changes of this kind are constantly going on in South America. In the Straits of Magellan the earth has been raised more than 16 feet, Talcahuano 17 feet, Vina 12 feet, in twelve years, and Cobija 5 feet in two years! the earth has also been perceptibly raised within a few years at Panama and San Blas. Disturbing causes, apparently of a more violent character, have upheaved the mighty Himalaya ranges, and which have borne up with them vast beds of the oolitic system. Ammonites and Belemnites have been dug out of their sides along the line of perpetual snow, 17,000 feet over the level of the sea! I have witnessed very similar examples of upheaval in the Alps and Pyrenees; some of the loftiest crests and basset edges of vertical strata, of the older rocks in the latter are occasionally covered by members of the secondary formations, &c. These few examples may serve sufficiently to show the power and general distribution of such stupendous phenomena. And we are not without abundant evidences of their startling operation within the confines of our own island. In the peninsula of Morven, Argyleshire, consisting principally of gneiss, an instance in point occurs, too remarkable to be passed over in silence. The coal and its concomitants here in some places occupy the summits of primary mountains exceeding 2000 feet in elevation.

Recurring to the tracts more immediately under consideration—the secondary and tertiary districts of England; many striking proofs present themselves of these great mechanical disturbances having taken place here, also, on a very extensive scale, and, in all probability, during the tertiary epoch. As, for instance, is exhibited by the anticlinal axis of the Wealden groups,—the axis of subsidence in the cretaceous beds, the vertical arenaceous, and chalk strata of Alum Bay,—the junction of vertical and contorted chalk beds at Ballard Head, Dorsetshire, and in the apparently sudden changes in their area, as inferred by the alternations of marine and fresh-water deposits of the Isle of Wight, and which of itself is (as the effects of some violent convulsion) considered as a disrupted mass of the formations of the adjacent south-east coast of England. The sites of many very similar dislocations, faults, &c., might also be pointed out in the lias, oolites, and other secondary districts, and in which, undoubtedly, numberless other such examples exist, but are effectually concealed from human ken by the vast beds of adventitious clays and other diluvial detritus, often so extensively concealing the regular formations. In fact, whatever may have been the magnitude of the mechanical movements we are contemplating, and which may in numerous instances have brought up the coal measures in question, it is most evident that the original surface effects thereof must have been greatly modified or entirely obliterated by the aqueous causes which gave the last general outlines or configuration to the face of the sedementary districts we are descanting upon. It is impossible to contemplate those vast superficial deposits designated the boulder-clay, so generally spread over the midland counties, &c., without being forcibly impressed with ideas of the mighty denudating and transposing power of the oceanic currents and surges, which during a glacial post-tertiary period swept over all that is now Britain, save a few groups of islets. And in making trials for coal it is obviously requisite to avoid as much as possible commencing operations on the surface of any of these adventitious accumulations, not unfrequently constituting extensive hill ranges, and imparting a very different aspect to the landscape to that which, on a general scale, the underlying stratification would have presented.

The most southern actual experiment for coal of any magnitude was made several years ago near Northampton, and which, though carried on to a depth of not more, I believe, than about 150 fathoms, disclosed some mineralogical features, &c., certainly as unlooked-for in that geologic position by most professed geologists as the coal itself, and certain of whom are, even now, wont to refer to the trial as a triumphant proof of the correctness of their own peculiar views and sweeping condemnations of all such attempts to discover coal in secondary districts at all remote from our central coal-fields. That the experiment (which was commenced in the middle oolite) was begun in ignorance of its true geological site, there can be little or no doubt; but it would appear as unquestionably correct, that the operations terminated in the new-red-sandstone—the very portals of the great coal formation! Whilst they were in the act of penetrating through a series of thin beds of limestone at a depth of some 280 yards, my opinion was then asked on the prospects of the undertaking, and from the characteristics of the sectional developments up to this period, I expressed a belief that they were actually approaching

the confines of the geological position of the red sandstone, and this prediction was shortly after announced to me as having taken place (and which was afterwards confirmed by a visit of Dr. Buckland's), as also the discovery of a strong brine spring therein, so peculiar to that formation. On subsequently visiting the scene of operations, accompanied by my friend J. Marsh, Esq., house-surgeon of the Northampton Infirmary, we found the pit banks completely encrusted by a saline efflorescence, left there by the evaporation of water last pumped up from the mine. This discovery alone, in a trial commenced on the surface of the oolitic ranges, was a very significant fact, and added considerably to the interest evinced in this important and formidable enterprise.

You, sir, in the course of some pertinent geological strictures on this pregnant question—which you are free to admit is a national one,—have suggested a trial still further into these unexplored regions, "on the outcrop of the upper oolite formation in the neighbourhood of Aylsbury, in Buckinghamshire;" and it would appear you name this situation, as being clear of the tertiary strata, and with a view to the ascertainment therein of some of the singularly-developed features of the Belgium and adjacent French coal-fields, where the chalk reposes immediately upon the coal measures. And, indeed, any trial made in the above districts would, as you intimate, possess an additional incentive as a central position, and in the comparatively near approximation of the Warwickshire and our other southern coal-fields. Of course, in all speculations of this locally unindicated and extended character, it is always necessary, in order to obviate undue prejudices, to take such enlarged and comprehensive views of the operations of Nature, as are, at least in some degree, commensurate with her magnificent realisations, and thus to labour to judge of things as they are, to estimate them according to their true character.

From the various facts and geological deductions I have now somewhat elaborately adverted to, as more or less affecting the important question at issue, I trust it has been rendered abundantly evident, that vast stores of the invaluable mineral on which both our national prosperity and progress are mainly based, exist at depths accessible to man beneath the secondary districts under consideration; and though the solely experimental trials for coal therein, may naturally be expected to involve more of risk, trouble, and expense, than the majority of such operations in the ordinary coal fields, we should not be unmindful that they may result in unsealing *new fountains*, rife with the elements of that wealth which must henceforth inevitably diffuse itself over the thirsty land in ten thousand fertilising rills, destined to impart force and volume to the ever-expanding waves of British commerce and civilisation.

Your intelligent, practical, Newcastle correspondent (who, on this subject, has also given us very striking instances of the wide differences in the estimated thicknesses of the sedimentary systems, as published by scientific men, as also examples of the occasional absence of whole formations), states his estimation of a "workable depth," to extend to some 300 or 400 fathoms. Now, if in some of the instances in question it were even found necessary to approximate to such immense depths, there can be no doubt that the very powerful mechanical appliances we have now at command, would be found quite adequate to the successful accomplishment of even such cyclopian undertakings; though, for the reasons advanced, not the least cogent of which is the nearly horizontal position so generally observable, of the secondary deposits, the high probabilities are, that in a vast majority of the experiments, comparatively shallow depths would suffice for the accomplishment of the primary object.

However, as one of the most remarkable proofs of the vast importance attributed to successful enterprises of this kind, I may here, *en passant*, advert to an undertaking commenced, for coal, at Wearmouth, near Sunderland, in 1826. After sinking to a depth of 100 yards, a spring was reached, which poured water into the shaft at the rate of 3000 gallons per minute. Having overcome this obstacle, and sunk to the depth of 500 yards, another spring was encountered, but this also being conquered, the sinking was continued several hundred feet lower, when the perseverance of the proprietors was rewarded by the appearance of valuable seams of coal. But 100,000*l.* were expended (chiefly owing to the vast unusual influx of water), and 10 years transpired before they realised any returns.

It is satisfactory to reflect that, in the present day, trials for coal in the unexplored districts are not very likely to be engaged in, in ignorance of their true geological character; and hence, whoever chooses to co-operate in such a "dig for hidden treasures" may, to a material extent, make his own individual venture with due discretion. The recent discovery of the valuable and important oolitic iron ore beds, gives additional importance to the development of the coal series in such localities; inasmuch that this ore, which is now being conveyed to the distant furnaces of Staffordshire, by hundreds if not thousands of tons daily, would, of course, be far more advantageously smelted on the spot, and where, as near the Northampton iron mines, lime (its flux) is abundant; and as the clay iron ore of the former field is, notoriously, becoming very scarce, the wealthy ironmasters may, ere long, be induced to erect their smelting establishments on or near the new iron beds, as is now being so extensively done on the Cleveland oolitic ranges; and then it is highly probable that some dashing and effective attempts may be made to realise the above primary result.

The statistical facts, &c., adduced in the first portion of this article, are assuredly, both as regards the enormously increasing consumption and prospective supply of coal, alone, most amply demonstrative, that the extension of our known coal fields, or the discovery of new ones, has become a question of vast and vital importance to the whole community; and I trust it has been sufficiently exemplified that geological induction gives its abundant testimony to the probability and practicability of effecting such pregnant realisations in districts occupied by the superincumbent or secondary formations. And as the question in all its bearings becomes more generally understood and appreciated, it will undoubtedly arouse and enlist the indomitable energies of British enterprise, in this age of progress, so productive of great and glorious results; for true though it be, that multitudes find no small difficulty in divesting themselves of the pertinacious burs of prejudice, and are slow in the recognition of new truths, no sooner are even *their* minds struck with the lightening of conviction, than, for the most part, they are willing to act, prompt to execute. The recent gold discoveries are strongly corroborative of this remark. And the bard of Avon, though less complimentary, but with equal truth, says,

> "The Jewel that we find, we stoop and take it,
> *Because we see it;* but what we *do not see*,
> We tread upon, and never think of it."

There is one other, and that, certainly not the least important aspect, in which we may satisfactorily view the great question at issue. It is impossible for any one who thoughtfully investigates the nature and distribution of the materials constituting the crust of the terraqueous globe, not to be impressed with the most indubitable convictions, that they are not only the operations of Almighty power, but of infinite wisdom and goodness. And so manifest are the beneficent arrangements of the earth's strata, &c., we constantly find that the substances most calculated to contribute to the wants and purposes of human existence are not only the most abundantly disseminated, but often singularly rendered the more readily attainable. And when the proper time arrives for the development of the mineral—more precious than Golconda's gems, or Eldorado's gold—stored up beneath the vast unexplored area, on which we have been speculating, we may rest assured that the manifold appliances at command will be found fully adequate to the designed and contemplated ends. And, although such undertakings may possibly demand more than an ordinary amount of patient industry and ingenuity, they would be infinitely compensated for by the consideration, that the actual disclosure of these mighty treasuries would be hailed as a new and inexhaustible source of human advancement and happiness, a mighty strengthener of the right-arm of British power and usefulness, and as an especial blessing to the millions of the English metropolis.

JOSEPH HOLDSWORTH.

Edinburgh, April 30, 1854.

ON THE EMPLOYMENT OF WATER IN FILLING UP DEEP BORE HOLES IN BLASTING OPERATIONS.—In working the great deposit of magnetic iron ore, which occurs under peculiar circumstances, in the granite at Moravitza in the Banat, it has been found necessary, in consequence of the hardness of the rock and ore, to use bore holes from 2 to 2½ in. in diameter, and 36 to 40 in. deep. The packing of such holes with clay being a very tedious operation, Mr. A. Keszt endeavoured to substitute water for the clay, with considerable success. One of Bickford's safety fuses, which burns in water perfectly, is attached to the cartridge and fastened with thread; this cartridge is let down to the bottom of the hole, and about 1½ to 2 in. of clay firmly packed over it, the remainder of the bore, to nearly the top, being filled with water. In the case of very oblique bores, where the pressure of the water upon the bottom was small, he plugged up the orifice of the bore with a plug of wood, driven with considerable force into it, through a slit in which the fuse passed. More recently, still he had used instead of a small quantity of clay first introduced, to keep the cartridge from being wetted by the water, a mixture of tar and pitch, which most effectually preserves the powder from damp. Great numbers of trials have convinced him that the blasts fired with this arrangement lose nothing in force, whilst there is a very great saving of time and consequently of expense.—*Oesterr. Zeitschrift fur Berg-u-Huttenwesen.*

TREATMENT OF GOLD BY MERCURY.

Since the important discoveries of extensive deposits of gold in Australia and California, and to some extent the still more interesting and now well-ascertained fact that the precious metal is largely distributed in the primitive rocks of Great Britain, Wales, and Ireland, human invention has been taxed to the utmost to discover the best means of extracting it, and thus rendering the discovery profitable, and commercially available. As this subject is at the present moment of all-absorbing interest, and is of vast importance to every person connected with mining operations, and while it becomes a most exciting problem to the metallurgical chemist, we now propose to convey to our readers every information which past experience, and our facilities of enlightenment, enable us to impart.

Mercury, or quicksilver, differs from all other metals, in being liquid at ordinary temperatures. It has a silvery-white colour, with a strong metallic lustre, and is not, if pure, tarnished by exposure in the cold to a moist atmosphere. If, however, it contains traces of other metals, the amalgam is rapidly oxidised, and the surface quickly covered by a grey-coloured powder. This metal is solid at 39° to 40° below zero, and is then both ductile and malleable. In polar latitudes the cold is sometimes so intense as to cause the congelation of mercury, and a similar result may be obtained by artificial freezing mixtures. Considerable contraction takes place at the moment of congelation, for while its density at 47° is 13·545, that of frozen mercury is 15·612. It is sometimes adulterated with lead and bismuth, but such impurities may be readily detected, both by the less perfect fluidity of the mixture, and also from its leaving a residuum, when sublimed, in an iron spoon. The mercury of commerce, as it comes directly from the mine, is in most instances nearly pure, but when found to be adulterated, it should be distilled in an iron retort. For this purpose, one of the iron bottles in which it is imported may be conveniently employed. One of these, half filled with mercury, should have attached to it a piece of iron gas-pipe, bent at right angles, and furnished at its open extremity with a tube formed of several layers of linen, or cotton cloth, the end being plunged in a basin containing cold water. This end of the pipe and the hose are constantly kept cold by a stream of water made to flow over them from a stop-cock; the iron bottle is heated in a furnace, when the vapour of mercury will be plentifully given off, condensed in the water, while the foreign impurities will be left in the retort. A certain portion of the impurities is, however, by this process, carried over, though small; and if a perfect purely specimen is required, it must be treated by nitric acid. When merely soiled by a slight admixture of oxide, it is readily removed by brisk agitation in a glass bottle, with sulphuric acid; at the expiration of three or four days the acid may be poured off, and the purified mercury washed and dried. Mercury combines readily with other metals, as gold, silver, zinc, tin, lead, arsenic, and bismuth, and forms, when in suitable proportions, solutions of those metals. This amalgamating property causes it to be extensively employed in extracting gold and silver from their matrices, as also in gilding, plating, and the manufacture of looking-glasses.

In the principal gold reduction works in the Brazils, Chili, Peru, &c., the most common method to obtain it is by stamping and washing. In the Tyrol, however, small quantities of gold are extracted, by amalgamation, from an auriferous iron pyrites, the operation being performed in a sort of mill, of simple construction. It consists of a flat-bottomed conical basin, the upper diameter being the largest, somewhat resembling in shape a dairy-pan, for milk, securely screwed down to a strong wooden table. It has a tube in the centre, for a rotating-shaft to pass through, to which is affixed a frame carrying a muller, which nearly fits into the annular space, and made hollow, sloping towards the centre. The pyrites having been first reduced to a fine powder, is introduced into the first of a series of these basins, in all of which a certain portion of mercury has been placed, and the mullers being set in motion, and a stream of water turned on, the mercury takes up the films of gold, and the debris is carried into the next mill, when any gold which may have escaped the first, will probably be taken up in the second; at all events, by the time it has passed five or six of these mills, not a particle will remain in the debris carried away by the water. These mills are allowed to work five or six weeks consecutively, when the mercury is drawn off, filtered through chamois leather, and the amalgam separated.

The amalgamation of silver with mercury is a property which is taken advantage of in Europe, Mexico, and South America; and the process is, perhaps, more systematically and economically conducted at Halsbrücke, in the vicinity of Freyburg, that in any other European locality. The usual constituents of the ores there treated are sulphur, antimony, arsenic, silver, copper, lead, iron, and zinc, which are more or less mixed with various earthy minerals, besides sometimes containing small quantities of bismuth, gold, nickel, and cobalt. In the selection of these ores they are so assorted as not to contain above 7 per cent. of lead, or 1 per cent. of copper, as, by combining with the mercury, these metals give to the amalgam a pasty consistency, rendering the treatment difficult and expensive.

The mixture of the different ores is so arranged, that the charges to the furnaces shall contain from 75 to 80 ozs. of silver to the ton of mineral; and it is also essential that they should contain a certain portion of sulphur. This usually exists in the form of iron pyrites; but if, as is sometimes the case, the amount of pyrites in the ore is insufficient, addition is made of this mineral, or of ready formed sulphate of iron. The ore thus prepared is laid on a large floor, 40 feet in length, and about 12 feet wide, and over it is thrown 10 per cent. of common salt, which is let drop from an upper room through a spout. The heap, made up of alternate layers of ore and salt, is carefully turned over, mixed, and made up into parcels of from 3½ to 4½ cwts., each called "roast posts." These are roasted in reverberatory furnaces, provided with fume flues for the reception of any pulverulent matters which may be mechanically taken over by the draught. The charge is spread on the bottom of the hearth, and at first very gently heated, to expel the moisture. During the process of drying (about two hours) the stuff is constantly stirred, and when this operation is sufficiently advanced the heat is increased so far as to cause the ignition of the sulphur, and to render the ore red-hot. The furnace is kept at this temperature four hours, when the metals become oxidised, and sulphurous acid gas is rapidly given off; constant stirring prevents the ore agglutinating in masses. The temperature is now further raised, and more sulphur is evaporated, with vapours of chloride of iron, and hydrochloric acid. This last firing lasts three-quarters of an hour, with constant stirring, until a sample gives no odour of sulphurous acid. The charge is then raked on the floor to cool, ground in mills, and passed through sieves, until a powder is produced, impalpable as the finest flour. At the Halsbrücke Works there are fourteen roasting furnaces, and as many pairs of granite millstones, which together are capable of preparing and grinding 70 tons of ore per week.

The re-actions produced by the process of roasting are the following:—The sulphurets of iron and copper give off sulphurous acid gas, and are transformed into oxides and sulphates. The sulphuret of silver, on being heated in contact with the sulphates of iron and copper, is also converted into sulphate, while these metals become oxidised, and sulphurous acid is evolved. The sulphates of iron and copper, together with the salt, become fused even below a red heat, and if sulphuret of silver be present in the mixture, a further amount of sulphurous acid is evolved, through the decomposition of that mineral produced by the re-action of its sulphur on the sulphuric acid of the sulphates; while sulphate of soda, chloride of silver, and the chlorides of copper and iron, are formed at the same time. When these re-actions are conducted with free access of air, the iron becomes partially converted into a sesquioxide, and a corresponding quantity of the sesquichloride of that metal is produced. The sulphurets of antimony and arsenic are likewise at the same time oxidised, and we may therefore regard the roasted ore as being composed of sulphate of soda, chloride of sodium, chlorides of manganese and lead, sequichloride of iron, subchloride of copper, chloride of silver, sundry earthy impurities, and various metallic oxides.

The amalgamation of this prepared ore is performed in 20 wooden casks, arranged in four rows, each turning on cast-iron axles, secured to the ends by bolts. They are 2 ft. 10 in. long, 2 ft. 8 in. in internal diameter, made of oak staves, 3½ in. thick, and further strengthened by iron hoops: on one of the ends of each is a toothed wheel, which by gearing with other wheels, in connection with a water-wheel, is kept in constant rotation; the prepared mineral is fed into the barrels by a hopper, having a leather hose as a terminus, and at the commencement of the operation 3 cwts. of water are run into each, after which 10 cwts. of the finely-powdered ore are introduced through the hose. To these are added from 78 to 100 lbs. of wrought-iron, cut into fragments of 1 in. square, and ⅜ in. thick, which, as they become dissolved, are replaced by fresh pieces. The casks are now tightly closed by screw stoppers, thrown into gear, and made to rotate 18 to 20 revolutions per minute. In two hours they are examined and as the paste is too thick, or too watery, water or powder is added. This attended to, 5 cwts. of mercury are added to each cask, when they are again closed, and set in motion, and kept constantly rotating from 16 to 20 hours, at the rate of from 20 to 25 turns per minute, during which period two examinations are made as to the state of the paste. At the expiration of the operation the tuns are entirely filled with water, and again set in motion for two hours, at the rate of eight revolutions per minute. The amalgam is thus separated from all slimy matters: when at rest it is found in one mass at the bottom of the barrels, and is run off into a proper receptacle. The residuary ore is found to have given up all its silver to within about 5½ oz. per ton, and is frequently subjected to a further amalgamation. In 14 days 160 tons of mineral are treated in this establishment, every 5 tons of which require an expenditure of 15 lbs. of metallic iron, and 2 lbs. 12¾ ozs. of mercury, so that every pound of metallic silver produced is obtained at an expense of 0·95 ozs. of mercury.

The mercury and amalgam obtained from the casks is afterwards filtered through close canvass bags, by which the liquid mercury is separated from the pasty amalgam, which is retained by the closeness of the web, while the mercury passes through into reservoirs prepared for the purpose. The pasty amalgam consists of six parts of mercury, and one part of an alloy, composed of about 80 per cent. of silver, and 20 per cent. of a mixture of copper, lead, bismuth, antimony, gold, nickel, zinc, and some other metals. This mixture is heated in a distillatory furnace, and is thus freed from the adhering mercury, while the non-volatile constituents of the alloy are obtained in the solid form.

The Mexican method of amalgamation, although the same in principle, is conducted under different mechanical arrangements. The mineral having been reduced to a fine powder is spread on the ground in large circular patches from 30 to 50 feet in diameter, and 1 feet thick, called "tortas." At Zacatecas, each torta contains 60 tons. In the centre of the heap is thrown 150 English bushels of salt, mixed with earthy impurities, and is intimately mixed first by wooden shovels, and afterwards by the treading of horses or mules. When thus mixed, they are allowed to remain until the next morning, when, after an hour's treading, from ½ to 1 per cent. of copper pyrites, called "magistral," is added, containing about 10 per cent. of sulphate of copper, which appears to be the active principle that effects the subsequent chemical changes. The torta is again well trodden by horses or mules; and, when perfectly incorporated, a quantity of mercury is added through a canvass bag, which delivers it in innumerable small jets over every portion of the surface. It is then alternately trodden, and turned by wooden shovels, until the silver has taken up all the mercury. A second portion is added, and the same process repeated until no more mercury can be absorbed. The duration of the operation varies considerably in accordance with the nature and richness of the ores and the temperature of the atmosphere; in winter the re-actions proceeding less rapidly. The amalgam is then washed, the fluid mercury separated by leather or canvass bags, and the amalgam sublimed in a furnace producing the resulting metals in a solid state. We have thus given an outline of the modes of smelting in Europe and South America; and to those interested who are anxious for further information, we recommend a *Manual of Metallurgy, or Practical Treatise on the Chemistry of the Metals*, by John Arthur Phillips, which gives elaborate details of all the several operations of smelting, assaying, amalgamating, and every metallurgical process.

BRAZIL AND ITS RIVERS—THE FALKLAND ISLANDS.

A work on the Brazils, and the commercial value of the districts watered by the Amazon, the La Plata, their tributaries, and other rivers, by Mr. Wm. Hadfield, secretary to the South American and General Steam Navigation Company, has just been published by Messrs. Longman and Co., containing much valuable information on this rich and prolific country, as also of Lisbon, Madeira, the Canaries, and Cape Verd Islands, well and beautifully illustrated by portraits, maps, charts, plans, and views. In it we are informed that previous to 1850 the eastern coast of South America, including the extensive and flourishing empire of Brazil, and the boundless regions watered by the La Plata, and other rivers, and their tributaries, were entirely without European steam navigation; sailing vessels, and a monthly sailing packet from Falmouth, conveying mails, were the only medium of communication. In that year the Royal Mail Company commenced a contract entered into with Government to run a monthly steamer from Southampton to Rio Janeiro, and a branch steamer to the River Plate. These perform the voyage with regularity in half the time formerly occupied, and the consequence has been an augmentation of traffic, both goods and passengers, such as few persons contemplated, and the company became unable to deal with either to the extent required. The South American and General Steam Navigation Company was, therefore, formed, and in 1853 commenced to run steam-vessels regularly between Liverpool and Brazil. Although nearly four centuries have passed away since the discoveries of Columbus and his followers, it was only in 1500 that that of Brazil was effected by Alvarez de Cabral, he having landed by accident through stress of weather at Porto Seguro on the 24th April, calling the country Santa Cruz (Holy Cross), in gratitude for his delivery from shipwreck, but which was afterwards altered to Brazil, signifying red wood, which it so abundantly produces; and four years afterwards Amerigo Vespucci explored the coast, and immortalised his name by giving it to this immense continent, both north and south.

In describing the empire of Brazil, the author informs us that it extends from 4° of north to 33° south latitude, its length from 2500 to 2600 miles, and breadth above 2000 miles at the widest part, and contains about 2,500,000 square miles, comprising every description of soil and culture, and having a great variety of climate, with a population variously estimated at, from 6,000,000 to 7,000,000. Its provinces are Para, with a capital of the same name; Rio Negro, an internal province on the Amazon; Alagoas, Bahia, and Maranham, on the sea coast, containing not more than 250,000 inhabitants to an area of 70,000 square miles—its chief production is cotton; Ceara, a sandy district, with a good back country, where many cattle are bred, but which suffers much from occasional droughts: it exports a fair quantity of hides, and some cotton and fustic: gold, copper, iron, and salt, are among its yet undeveloped mineral resources. The most vital question affecting the development of the resources of the Brazils at the present moment is the promotion of railway undertaking. The first effort has been made at Rio Janeiro, where a short line of 10 miles, which connects that city with Persepolis, a thriving little place up the mountains, where the emperor has a palace. Other extensive lines are projected from Rio and from Pernambuco, the latter offering the strongest inducement to individual enterprise, passing as they will through hundreds of miles of cotton, sugar, and tobacco plantation districts. The author then proceeds to describe the valley of the Amazon, its rapids and cataracts, the Banda Oriental del Uruguay, (Monte Video), Buenos Ayres, and other portions of the empire, concluding with a brief description of the Falkland Islands, and showing their peculiar fitness as a place of refit, naval station, and convict settlement—a purpose to which they had been applied by their former occupants.

Mr. Hadfield has contrived to associate with him a whole corps of eminent South American authorities, who have rendered the aid of pen and pencil to enrich his valuable volume. Sir W. Gore Ouseley, so distinguished in the transactions against Rosas in the Plate; Sir C. Hotham, the late plenipotentiary to Paraguay; Admiral Grenfell, of the Brazilian service; Dr. Dundas, the learned medical writer on the *Climate of the Tropics;* Mr. Braga, the vice-consul at Bahia; and many others have assisted, and the result has been an infinitude of matter of miscellaneous interest. To all parties interested in South America the work will be found of much utility, and to the general reader highly amusing and instructive.

M. GAUDIN'S METHOD OF CAUSING DEPOSITIONS OF ALL KINDS OF METALS UPON ANY METAL WHATEVER, BY IMMERSION IN A LIQUID OR BY A CURRENT OF ELECTRICITY.—Hitherto the solutions employed in depositing one metal upon another by electrical agency have been made with one or more salts of the metal to be deposited, the strength of the solution being subsequently maintained by the gradual dissolution of anodes of the same metal placed in the baths. M. Gaudin proposes to form his precipitating bath without the use of any metallic salts, except those produced by the dissolution of the anode alone. For this purpose he makes a saturated solution of common salt, with the aid of heat, allows it to cool, filters it, and then adds 1-200th of its weight of oil of vitriol, allows it to repose for 24 hours, and then filters it again. Into the solution thus constituted an anode of the metal to be precipitated is plunged, and in two hours it will be ready to give a deposit of metal by connecting it with a battery. Thus, to produce a bath that will yield a deposition of silver by ample immersion, it is only necessary to dissolve part of a small piece of silver in it, and to allow the remainder to lie in it, and in 24 hours the bath is ready. He considers such a bath to be adapted to the deposition of gold, silver, tin, copper, iron, zinc, platina, &c. There is nothing very new in this process, still, if it should be found to answer, it would be more economical than forming the solutions in the first instance with expensive salts.—*Armengaud's Publication Industrielle.*

MANUFACTURE OF IRON.

COST OF PRODUCING IRON IN SCOTLAND COMPARED WITH THAT IN SILESIA, AND WITH THE MOST IMPROVED SYSTEM OF CHARCOAL SMELTING ON THE CONTINENT.

One of the chief barriers to the introduction of free trade, or at least of a greater approach to it, in France and Germany, has been the fear of destroying the iron trade of those countries, which is very considerable—that of France having been, in 1846, 522,000 tons, and being now perhaps not far from 1,000,000 tons; while that of Prussia, in 1851, was 348,000 tons. As it is not probable that so important a branch of industry will be sacrificed in either country, the only way in which free trade can arrive will be by removing the necessity for protection—that is, by introducing such improvements into the manufacture as will lower the cost of production to the standard of Great Britain. The following facts may help to show whether such is possible or not:—

According to the *Mining Journal*, No. 821, p. 237, for 1851, the average cost of producing 1 ton of common Scotch pig-iron in that year was—

32 cwts. of calcined ironstone (black or clay-band), and containing 62·5 per cent. of iron, at 12s. per ton	£0	19	2
45 cwts. of coal, at 4s. per ton	0	9	0
16 cwts. of cinders, at 1s. 6d. per ton	0	1	3
7 cwts. of limestone, at 3s. 6d. per ton	0	1	3
Labour at the smelting-works	0	3	3
Sundries, inclusive of horses	0	2	0
Interest upon capital (20,000*l.* for a furnace, inclusive of all other outlay at the smelting-works and mine)	0	3	4
Total	£1	19	5

According to Mr. Eck, Inspector of Smelting-works in Silesia, and Mr. Chuchul, machinist,* the average cost of producing 1 ton of iron in Scotland, as calculated from the average cost of the raw materials employed at the chief works, is as follows:—

35 cwts. of calcined ironstone (blackband, supposed, on an average, to contain 37 per cent. of iron), at 10s. per ton	£0	17	6
2 tons 5 cwts. of splint coal, at 3s. 8d. per ton	0	8	3
10 cwts. of limestone, at 4s. 6d. per ton	0	2	3
Three quarters of small coal, at 1s. 6d.	0	1	1½
Labour at the furnace	0	1	0
Interest upon capital, wear and tear of furnaces and blast apparatus, and sundry expenses, usually reckoned in Scotland at 6s. per ton	0	6	0
Total cost of 1 ton of Scotch pig-iron	£1	16	1½

In many of the German iron-works, from the smallness of the furnaces, the superior quality of the iron, which fetches a much higher price than the commoner kinds of British, and especially Scotch iron, joined with a considerable protection, the economy of working was not, up to a late period, carried to the same extent as in France, and now to a considerable extent in Great Britain. The average cost of production in Germany of coke pig-iron approximates very closely to that established with great care at the furnaces of the Konigshutte, in Upper Silesia, and which may be thus stated:—

Ore	£1	0	8½
Coal	1	1	8½
Lime	0	1	10 4-5
Small coals	0	5	2½
Wages	0	3	1½
Wear and tear, management, interest upon capital, &c.	0	11	10½
Total	£3	4	6

Silesian iron would thus appear to cost, according to the first of the preceding estimates, 1*l.* 5s. 3d. more than Scotch iron, or 1*l.* 8s. 4½d. according to the second, or 64 per cent. and 78 per cent. respectively. In the Scotch estimates, the coal is reckoned at cost price at the mines, the latter being supposed the property of the proprietor of the iron-works; whilst in the German, on the other hand, the coal is calculated at the usual selling price. By allowing for this difference, the German estimate will be reduced to the extent of 10s. 10d.—that is, 1 ton of pig-iron will cost in Silesia 2*l.* 13s. 8d., or 14s. 5d. more than Scotch pig, according to the first estimate, and 17s. 6½d. according to the second, or 36 per cent. and 48 per cent. respectively. A considerable reduction could be effected in the item of management, which, according to the preceding estimates, is nearly double as much in Silesia as in Scotland, if the trade increased so as to enable the works to be increased. The iron-works of the latter have generally twice, and sometimes four times, as many furnaces as those in the former, and each of these is also generally capable of producing perhaps four times as much iron: hence the greater expense under the head of management in Silesia. Several other improvements may also be introduced so as to lower the expenses of working, such as an improved method of removing the cinder, the substitution of machinery for hand labour in lifting the ore to the top of the furnaces (a method which is very generally practised with small furnaces), the better economising of the waste gases, &c. Another item to be also taken into account is the superior quality of the German iron, and the greater loss sustained in remelting Scotch pigs, from the adhering coarse moulding sand. Summing up all the deductions which may be thus made, it is probable that iron can be produced with coke in the coal districts of Germany, and in certain of those of France, for 2*l.* 10s.; but it is very improbable that it can ever be made as cheap as in Scotland, from the co-existence of certain circumstances there which scarcely exist anywhere else. Iron cannot, however, be made in other parts of Great Britain as cheaply as in Scotland; and it is probable that the average cost of producing 1 ton of pig-iron of the same quality is fully as high, if not higher, in England than what we have just set down as the minimum cost in Germany. From these calculations, which, with a considerable amount of other valuable information, we have gleaned from the *Mining Journal*, it would appear that German, and we may add French, coke-made iron will very soon be in a position to compete upon equal terms with that of Great Britain.

Let us now see how the case stands with regard to charcoal iron. Instead of giving the results obtained at any particular iron-works, we shall quote the opinion of perhaps the best authority in Europe upon the subject, M. Leplay.† From the most elaborate calculations, founded upon the present working of iron in Styria and Carinthia, he has come to the conclusion, that by a proper cultivation of the forest, which should be in the hands of the ironmaster, the economical production of the charcoal, and the most improved system of smelting, &c., the cost of producing 1 ton of charcoal pig-iron would not be more than 2*l.* 18s. 3⅝d., as is seen from the following statement:—

50 cwts. of ironstone, at 8s. 4½d. per ton	£1	0	11¼
5 cwts. of flux (limestone), at 2s. 4½d. per ton	0	0	7⅛
23 cwts. of charcoal, at 1·9s. 2¼d. per ton	1	2	1
Wages, calculated upon the basis of a weekly production of 271 cwts. of pig-iron	0	1	9⅛
General expenses—management, wear & tear, rent, sundries, &c.	0	8	5
Interest upon capital, including land, at 10 per cent. upon 27,750*l.*	0	4	5⅛
Cost of 1 ton of charcoal pig-iron	£2	18	3⅝

This scarcely exceeds the average cost of producing 1 ton of superior coke iron in England, notwithstanding the cheapness of fuel, and the other unexampled advantages, as an iron-producing country, which Great Britain enjoys. There is, therefore, sufficient margin left for improvement, to enable the continental ironmaster to produce iron, whether with coke or with charcoal, at a cost sufficiently low to compete unprotected with British iron.

The same observations apply with equal force to the manufacture of bar-iron from charcoal pig-iron. According to Leplay, the following table may be considered to represent the cost of making 1 ton of charcoal bar-iron, if the manufacture be carried on upon the best principles:—

25·19 cwts. of charcoal pig-iron, at 2s. 11d. per cwt.	£3	13	5½
40·8 cwts. of dried wood, at 7s. 2½d. per ton	0	17	11⅝
Wages	0	9	0¼
General expenses—management, wear and tear, &c.	0	14	5¼
Interest upon working capital, and capital sunk in forest land, at 10 per cent. on 66,000*l.*	0	14	5¼
Cost of 1 ton of charcoal bar-iron	£6	9	3⅝

Or, if we deduct the sum allowed for interest upon capital, the cost of producing 1 ton of charcoal bar-iron would be 5*l.* 14s. 10½d., a sum below which the price of English bar-iron has hitherto rarely sunk, and to which it will scarcely again fall, with the increased price of fuel in every part of Great Britain.—*Journal of Industrial Progress.*

GLUE IMPERVIOUS TO WATER.—If a coating of glue or size be brushed over with a decoction of one part of powdered gall nuts in twelve of water, reduced to eight parts and strained, it becomes hard, and as solid and impervious to water as a coat of oil paint; in fact, a kind of leather is formed. It makes a good coat for ceilings to whitewash on, and for lining walls for paper-hangings.

* Zeitschrift fur das Berg Hutten, und Salinenwesen in den Preussischen Staale—Herausgegeben von R. V. Carnall. Bd. 1, Lief 2.
† Annales des Mines, 1853. Tome III., p. 463.

SMOKELESS AND ECONOMICAL DOMESTIC FIRE-GRATE.

At the Society of Arts, Adelphi, on the 10th inst., NEIL ARNOTT, Esq., M.D. and F.R.S., read a paper on the evils connected with common coal fires, and the best means of constructing a grate for every use in dwelling-houses, which, while it was simple and thoroughly efficient for the purposes intended, should not be costly in the first instance, or in the application of the principle to existing stoves, and be greatly economical in the consumption of fuel. The evils attendant on the present grates were—production of smoke, waste of fuel, and defective warmth and ventilation. A close examination of the question has shown that in London alone, on account of its smoke-laden atmosphere, the cost of washing the clothes of the inhabitants was on an average 1s. per head per week, or 5,000,000*l.* sterling per annum, being greater by 1,500,000*l.* than for the same number of families residing in the country. This, also, is but a small part of the evil; articles of furniture and decoration are injured, and even the external surfaces of stone of which edifices are built; flowers are covered with sooty dust, and sheep placed to graze in any of the parks have soon dingy coats. The atmosphere is also inimical to the health of man, as proved by the bills of mortality, and children brought from the country cease to thrive. With respect to the waste of fuel, the paper stated that to save a third part of the coal consumed in London would amount to more than 1,000,000*l.* a year? and when coal is very dear, as during last winter, the saving would be much greater Count Rumford, a writer of great authority in such matters, after making many elaborate experiments, declared that five-sixths of the whole heat produced in an ordinary English fire goes up the chimney with the smoke, to waste. This estimate is borne out by the facts observed in countries where fuel is scarce and dear, as in parts of continental Europe, where it is burned in close stoves, which prevents the waste, and with these a fourth part of what would be consumed in an open fire suffices to maintain the desired temperature. He had himself made experiments here with like results. Now, it is to be considered that coal is a part of our national wealth, of which whatever is once used can never, like corn or any produce of industry, be renewed or replaced. Then, the coal mines of Britain may truly be regarded as among the most precious possessions of the favoured race which occupies these islands, and without which they could never have attained the importance in the world which the extraordinary development of their mental and bodily faculties has now given them. It is enough to say that without coal they would not have had the steam-engine. To consume coal wastefully or unnecessarily should not be called merely improvidence, but is a serious crime committed against future generations. On the defects of heating and ventilating in dwellings, it stated that, calling 1000 a week the average rate of mortality in London alone, it was found for some weeks of the very cold winds in the middle of last winter, that nearly 700 deaths more occurred, owing to the intense cold which then prevailed, and against which the existing arrangements for warming and ventilating were insufficient. Not a little of the premature mortality at all times, of the spread of epidemics, and of the low condition of health among the people, is doubtless owing to the same cause.

The writer then proceeded to consider whether it would not be possible to avoid the three great evils above described, and at the same time to secure still further advantages.

Various attempts have been made to feed the fire from below instead of on the top—the most important of which was made by Mr. Cutler, an ingenious manufacturer, 30 years ago, who took out a patent; but a trial at law afterwards decided that he had no patent right.

Mr. Cutler placed a box filled with coal immediately under the fire, with its open mouth occupying the place of the removed bottom bars of the grate; and in the box was a moveable bottom supporting the coal, and by pressing which the coal was lifted gradually into the grate to be consumed. The apparatus for lifting, however, was complicated, and liable to be out of order, which, with other reasons, has caused the stove to be little used.

In the new grate described in the paper, Dr. Arnott has sought the greatest possible simplicity of parts, joined with complete efficiency. The charge of coal for the whole day is placed in a box immediately beneath the grate, and is borne upward as wanted by a piston in the box simply by the poker used as a lever, and as readily as the wick of an Argand lamp; while the fire is under command almost as completely as the flame of such lamp.

The fire is lighted with singular ease and speed. The wood is laid on the upper surface of the fresh coal filling the coal-box, and a thickness of 3 or 4 in. of cinder, or coked coal, left from the fire of the preceding day, is placed over it. The wood being then lighted, instantly ignites the cinder above, and at the same time the pitchy vapour from the fresh coal below rises through the wood flame and cinders, and becomes heated sufficiently to inflame itself, and so to augment the blaze. When the cinder is once fairly ignited, all the bitumen rising through it afterwards becomes gas, and the fire remains quite smokeless for the remainder of the day. A fire-place supplied with coal from below was used by a distinguished engineer in town for 10 years, and the chimney had not to be swept the whole of that time, because there was no soot formed.

In the new grate, because no air is allowed to enter at the bottom of the coal-box, there is no combustion below, but only between the bars of the grate, where the fuel is completely exposed to air, and near the mouth or top of the coal-box. The unsatisfactory result of some other attempts to make such a fire have been owing in part to the combustion extending downwards in the coal-box, because of air admitted below, and the consequent melting and coking of the mass of coal, so as to make it swell and stick, and impede the rising of the piston.

A remarkable and most valuable quality of this fire is its little tendency to go out, or be extinguished. Even after nearly all the coal in the grate, or surrounded by the fire-bars, has been consumed, the air will dive into the coal-box, and keep the fire there gently alight, like a torch burning from the top downwards, until nearly the whole contents of the box are consumed, and thus the fire will remain burning for a whole day or night, without stirring or attendance, and yet at any moment it is ready to burn up actively when the piston is raised.

To obtain the necessary draught, and regulate the intensity of the fire, a hood is placed over the hobs, contracting into a narrow tube or funnel a foot or two up the chimney. In this tube is placed a throttle-valve, working by a knob, to which is attached a pointer needle on a dial-plate, immediately beneath the mantleshelf. By this arrangement any quantity of air may be admitted through the fire, as the atmosphere of the room, or other circumstances, may require—from the fierce action of the blast-furnace to a gentle breeze, just sufficient to keep up the combustion.

After enumerating the many advantages which will arise to society by the adoption of this invention, which Dr. Arnott freely gives up to the public, the remarkable fact was noticed, that of the only four things which Providence has left to man in various parts of the earth to procure for himself—viz., fit air, temperature, aliment, and work alternating with rest—the skilful management of his domestic fire goes far to secure the two first-named; but these are the last which men come to understand well, because things invisible and intangible, and, therefore, to be perceived only by the eye of the mind, after much cultivation.

The CHAIRMAN (Dr. Lyon Playfair) made some observations on the importance of the discoveries of Dr. Arnott. By making opaque smoke, a peculiar law of nature was opposed. He had often considered the subject, and had thought the conversion of coal to coke, employing the gas, and using the coke in our domestic fires, would be a desirable process; here, however, they had the two combined; the box was, in fact, a gas retort, and the gas passed through the incandescent fuel and burned with a smokeless flame at the top of the fire. He felt satisfied they would be highly economical, be conducive to great sanitary effects, and were applicable to every domestic purpose.

Lord EBRINGTON said that, from his position on the Board of Health, the evils resulting from badly ventilated apartments came constantly under his notice, and many thanks were due to Dr. Arnott for placing so valuable an invention at the disposal of the public. He had recently been in Paris, and was informed by gentlemen connected with the army in that city, that the soldiers were actually poisoned wholesale from inhaling foul air in their close and unhealthy barracks. He believed our modern rooms were not so well ventilated as those of our ancestors, and it was not to be wondered at that the poor should try to economise what heat they could obtain by completely closing all doors and windows, to the detriment of their health. He alluded to the bad smells in houses, which too often arose from the sewers being ventilated by bad management, and the vapours passed through our sitting and sleeping rooms.

A MEMBER here called attention to the wheel stove, as invented by Franklin, which, although like in principle, he thought more simple and effective than Dr. Arnott's. It consisted of a cylindrical case of fire-bars, having two doors opposite each other; coals were supplied at the top opening, when the grate was turned over, bringing the unconsumed fuel to the bottom, and the gases rose through the fire.

Mr. JOHN LEE STEVENS considered that the discussion of the evening should be confined to the paper so ably introduced by Dr. Arnott. He had taken out a patent for a new arrangement of domestic grate, and while Dr. Arnott gave his invention to the public, he looked a little to his own interest as well as the advantage of society. He believed that the stove under discussion was a highly important arrangement; that if parties could undertake the manufacture on a large scale, with many patterns at hand, very handsome stoves might be got up at an additional cost of from 25s. to 30s., and that cottage stoves, and the application of the principle to other grates, might be effected for considerably under 20s.

Mr. CHADWICK, of the Board of Health, in moving a vote of thanks to Dr. Arnott, remarked at considerable length on the evils inflicted on towns by a smoky atmosphere, both in the soiling and destruction of property. He had received a note from Mr. Clay, of Preston, showing a marked difference in the cleanliness of the town since the strike, and the consequent quiescence of the chimnies. The invention appeared to him mechanically correct, and he had no doubt would effect all Dr. Arnott claimed for it.

Mr. ENNIS seconded the motion, which was carried with acclamation.

The meeting was addressed by Dr. HOFFMAN, Mr. ROBERT HUNT, and other gentlemen, and Dr. ARNOTT replied, which terminated the proceedings.

VOLTAIC ELECTRICITY APPLIED TO MINING AND TELEGRAPHIC PURPOSES.

Mr. H. M. Noad, Ph. D., delivered his third lecture, on Voltaic Electricity, at the United Service Institution, on the 10th inst., being the last of the series—[see pp. 281, 297.] The principles of the electrotype were first described. A solution of sulphate of copper is placed in the porous cell of a Daniell's battery, in which the plaster, or wax model, from which a cast is to be taken, is placed, first being well coated with plumbago as a conductor. Hydrogen is then given off at the negative pole, and copper is deposited to any thickness required. Among the brilliant discoveries with which Faraday has enriched mankind, that of magnetic electricity was one of the most important. If a coil of insulated copper wire was made to revolve in front of the poles of a permanent magnet, a current of electricity would be evolved of great intensity, capable of rapidly decomposing water, and of giving out a dazzling light from two charcoal points. The chemical and heating powers of the voltaic current were then entered on more fully, with practical experiments: the heating powers depended on the resistance which the current met with, of which there were two sources—the resistance in passing through the exciting liquid employed, which, being a bad conductor, they were obliged to employ as thin a stratum of liquid in each cell as possible. The other source of resistance was in the wire, to overcome which thick copper wire should be used, particularly in long distances of telegraph; but, as this was very expensive, iron was employed, which often led to confusion in the messages. A discovery had been made by Professor Ohm, of Nurembourg, of a formula to discover the amount of battery power actually obtained; and which had been borne out by the researches of Wheatstone and Grove. The entire amount of power given out by the battery, divided by the resistance of the fluid, *plus* the resistance of the wire, gives the amount of power actually available. As distances increase, the number of batteries must be increased, or thicker wire employed. Dr. Noad then produced the electric light, and observed that the great obstacles at present were the expense of the battery, which could only be got over by its producing a residuum of commercial value, a patent for which had, he believed, recently been taken out (we expect the lecturer here alluded to the patents of the Electric Power, Light, and Colour Company), and the difficulty of keeping the charcoal points at the proper distance by mechanical means, a remedy for which at present appeared to him hopeless.

With respect to the conducting powers of the different metals, no two electricians agreed as to their arrangement, but every investigator had adopted a theory of his own; all, however, agreeing that silver, copper, and gold, were the highest in the series—platinum, palladium, and iron, the worst conductors. The resistance in these latter gave such great resistance to the passage of the current, that on completing the circuit they became intensely red or white hot, while silver or copper remained cold. Sir H. Davy, after numerous experiments on the conducting powers of metals, taking copper at 100, makes that of silver 109·1, gold 72·7, lead 69·1, platinum 18·2, palladium 16·4, iron 14·6. The better the conductor the less the resistance, and consequently greater the power. About 18 inches of wire were then heated to a white heat, and a beautiful experiment showed the different conducting powers of silver and platinum: a chain formed of long links of these metals, placed alternately, and when connected with the battery, the platinum glowed in daylight with a white heat, the silver links remaining cold. Some gun-cotton was then exploded at a distance; the combustion of silver, gold, tin, iron, and other metals shown burning with brilliant colours; and the lecturer explained the means of blasting in mines, quarries, and under water, by galvanism, and called attention to the great result at Round Down Cliff, where nine tons of gunpowder were exploded, and 600,000 tons of solid chalk hurled into the sea. Some general remarks on the principles of the electric telegraph concluded the lecture.

MANUFACTURE OF IRON.—At the Royal Institution, Dr. Noad delivered a lecture on the Manufacture of Iron. That metal, in consequence of its comparative infusibility, and its invariable association with other mineral substances, which increase the difficulty of working it, was not brought into use until after other metals; but mention of it is nevertheless made in several parts of the books of Moses, which shows that it was partially known in the early period of Jewish history. That it was not, however, in general use 2000 years ago was proved by the discovery at Herculaneum of several cutting instruments made of bronze, which, before the introduction of iron, was commonly used for that purpose. Of the various ores of iron from which the metal is usually procured the magnetic iron ore produces the best quality. It is found abundantly in Sweden and in the United States of America, and the iron of those countries is, consequently, of a superior character to most others. The carbonate of iron is, however, the richest of the ores, but it is not nearly so much used as the less productive, but more abundant, ironstone that is found accompanying coal in most of the coal measures. The association of iron with coal is an important advantage, as it requires about 3 tons of coal for the production of 1 ton of iron. The mountain limestone also, on which the coal strata usually rest in England, is eminently useful as a flux, for which purpose it is mixed with the coal and the iron ore bef re they are thrown into the furnace. The first process to which the ore is subjected is that of roasting, for the purpose of expelling the volatile matters, particularly sulphur, the presence of which, in even small quantities, greatly deteriorates the quality of the iron. The furnaces in which the roasted ore is reduced are generally about 45 feet high, and 12 ft. in diameter at the broadest part, contracting towards the bottom, where the crucible that holds the melted metal is placed. The "tuyeres," or nozzles of the bellows that introduce the blasts of air into the furnace, are cooled by being surrounded with fresh supplies of cold water, to prevent their being fused; and the continuous blast is kept up by a steam-engine. Dr. Noad stated that the quantity of air consumed in reducing iron ore exceeds in actual weight that of the ore, coal, and flux together, the proportions being 17 tons of minerals to 22 tons of air. As the volume of air required is so immense, its entrance into the furnace tends to diminish the temperature, an effect which is prejudicial to the manufacture of iron. To lessen this cooling influence, the plan of heating the air before it is admitted has of late years been introduced with very beneficial effects. The air is heated by passing it through a succession of hot tubes, and in this manner its temperature is raised to about 600° of Fah. By the aid of the hot-blast, inferior kinds of ore and coals can be employed, which could not be worked by the former method; the good ore yields more abundantly, and the quality of the iron is greatly improved. Dr. Noad stated that the attention of ironmasters is at present much directed to the cinders of the furnaces, which always contain a large proportion of iron, the quantity being greater when the action of the furnace is defective; and it is expected that by improved processes the waste iron may be recovered. In conclusion, he alluded to the important improvement which has been introduced of employing the waste gases of the furnaces for heating the blast, and for working the steam-engine. The hot gases, as they pass up the chimey, instead of being allowed to escape directly into the air, are conducted under the boiler of the steam-engine and among the pipes that heat the blast, by which means the fuel previously used for those purposes is entirely saved. It is a striking illustration of the unwillingness shown by our manufactures to introduce anything new, that the utilisation of the waste gases of the furnace was known, and in operation, for several years on the Continent before the plan was introduced into this country, and even now it is only partially adopted.

ON THE DIFFERENT METHODS PROPOSED TO PREVENT THE INCRUSTATION OF BOILERS, BY DR. L. ELSNER.—It is well-known that sawdust has been often proposed to prevent the incrustation of boilers. Roard recommended the sawdust of mahogany; according to Hill, that of oak acts very well. It would thus appear that it is not absolutely necessary to employ the sawdust of mahogany, but that that of other woods would produce the same results. The experience of the author confirms this supposition; the water containing a considerable quantity of gypsum, and which formed, when boiled for some time, a considerable calcareous deposition on the sides of the vessel, ceased to do so when boiled with the sawdust of different woods, even with that of common deal. It formed rather a thick mucilaginous liquid, which was easily removed from the boiler, and left the sides free from all incrustation. Ritterbrandt recommended the addition of sal-ammoniać, not only to prevent the formation of incrustation, but to dissolve off any that may have formed: the action of this substance depending upon the mutual decomposition of the carbonate and sulphate of lime in the water of the boiler and the sal-ammoniac with the production of carbonate and sulphate of ammonia, which are very soluble, and the still more soluble chloride of calcium. The author fully confirmed the experiments of Ritterbrandt, by the results of some trials which he made with sal-ammoniac upon well water abounding in gypsum. A very small quantity of that salt added to the water prevented all incrustation, and completely dissolved that which had previously formed. As, however, the quantity of gypsum and carbonate of lime in the water used for feeding boilers varies in different localities, the same quantity of sal-ammoniac is not always required to be added to the water. As a general rule, however, we may add a quantity equal to the whole of the solid matter contained in the feed-water, which may easily be determined by evaporating a gallon of the water and weighing the residue, and multiplying it by the number of gallons thrown into the boiler by the feed-pipe during a given time. In all cases, however, 1 part of sal-ammoniac to 1200 parts of water will be sufficient to prevent incrustations, or, what is the same thing, 1 lb. of sal-ammoniac to 20 cubic feet of water, and in many 1 lb. to 50 cubic feet, would be sufficient. The great objection to the use of sal-ammoniac is, that if the water contains carbonate of lime, which it invariably does where incrustations are formed, carbonate of ammonia will pass over in the steam, which cannot be used for many purposes; whilst the copper tubings and brass fittings are rapidly corroded. The author also obtained satisfactory results by the use of tanning materials. These substances produce a brown mud-like deposit, which does not adhere to the boiler, and can be readily removed. This mud consists of a combination of lime with tannic acid, and a brown colouring material. Among the tanning materials he recommends catechu, oak-bark, tormentilla, and several other wild plants; in all cases it is better to use the decoctions of these substances, as otherwise they would be open to the same objection as saw-dust, which is liable to get in the cocks, valves, &c. The author has also confirmed the observations of Guinon, that saccharine substances, such as molasses, glucose, &c., effectually prevent incrustations. These substances produce a mucilaginous brown precipitate, not at all adhesive, and capable of being removed with great facility

Some years ago Kuhlmann proposed the use of carbonate of soda, which has again been recently recommended by Fresenius, and notwithstanding the objections which have been raised against its use, Dr. Elsner finds that it acts perfectly. When, however, too large a quantity is employed it acts upon all the joints, cocks, lutings, &c., and destroys them in a short time; and to this cause alone he attributes the objections which have been made against its employment. If the proper proportion be employed, which may be easily ascertained in the way already indicated, no such injurous action need be feared. The same objection applies to caustic soda, which has been proposed by Dam, and which possesses no advantage whatsoever over the carbonate. Dr. Elsner also remarks, that boilers are never so clean with carbonate of soda as sal-ammoniac, which, apart from the disadvantages attending its use above mentioned, is undoubtedly the most effectual remedy against incrustations.—*Polytechnisches Centralblatt.*

THE MINES AND MINERALS OF AMERICA.—No. II.

BY CHARLES SAMUEL RICHARDSON, MINING ENGINEER.

THE OLD BRISTOL MINE, CONNECTICUT.—Although copper has been known to exist in this state for more than three-quarters of a century, little endeavours appear to have been made towards working any mines until about 15 years since, when a person by the name of Millar, assisted with funds by some English gentlemen, opened on some lodes in the northern part of the township of Bristol: they were led to explore here from certain unmistakeable surface mineral indications in the mica slate. It appears they drove a shallow adit level on one of the small lodes into the hill a short distance, and when it was found productive followed down the shoot of ore as far as they could, until their progress was impeded by the water. This system of stoping under hand, of course, did not pay; but it led to the discovery of the great lode. Here they appear to have sunk a large pit, and driven out shallow levels in several directions; some of the work raised must have been very rich, as the deads that remain will pay for stamping; the cost, however, in the end overbalanced the value of the produce of the workings, and the mine was suspended. We find it next under the management of Mr. Bradford, the inventor and patentee of the justly celebrated ore vanning machine. This gentleman, aided by ample capital, and the practical experience of some Cornish mine agents, opened the mine, by sinking an engine-shaft, erecting a steam-engine, crushers, jigging-floors, &c. At 20 fms. deep very rich courses of ore were found; the engine-shaft was put down 40 fathoms deep, and levels driven out about 90 fathoms; various cross-cuts, also, were driven, and in scarcely a single instance within the lode was a fathom of ground found without being mineralised. I am informed by the old office books, which, with the use of the chemical laboratory attached to the office, I had very kindly offered for my use during my stay, that during Mr. Bradford's management over $200,000 worth of ore was returned, and a very large quantity of this was dressed up to 30 per cent. It is true that at the latter part of the working of the mine little more was done than picking the eyes out of her; for unless the ore was very rich it was not sent to grass. I form this opinion from seeing thousands of tons of good orey ground still standing in the old stopes and levels, and in one of the old backs I found the stull pieces placed on a course of solid ore. I apprehend that the system pursued in prosecuting the works was very expensive; for, although such a large quantity of rich ore was returned, I find no profits made, or, at all events, no reference is made of any dividends having been declared. Four years ago the mine passed into the hands of Mr. H. H. Sheldon, as manager for the proprietors. As a prudent man, he considered the best way to work the mine properly would be to engage the services of those who understood the nature of such ground as he had to contend with; he was fortunate in selecting Capt. Williams, from Cornwall. Captain Williams had been many years engaged in the heavy ground of our western tin mines, and understood timbering in every kind of form: he had now got his hands full. A great deal of credit is due to Mr. Sheldon, whether the proprietors of the mine know it or not; for, at the time he took the entire management of the concern, the 30 and 40 fm. levels were full of water, the bottom lift drawn to grass, and in consequence of the soft nature of the ground, hundreds of fathoms of levels were run together; in fact, the greater part of the old workings were crushed in; all the rich courses of ore, except a few arches, were taken away above the 20 fm. level as far as could be seen at this time, and the mine presented altogether a very uncheering aspect; indeed, the old mine had been condemned by almost every one—geologists, agents, and miners; and said to be a mere bunch—that it was worked out. Capt. Williams, however, thought different: like an old tinner, he tried the mine with the shovel; the van made was quite to his satisfaction. Where there had been such a large quantity of ore taken away, as a Cornishman calculates, some little must remain; sure enough, he was quite correct. The mine was at this time not producing one ton of copper per month. Mr. Sheldon's first operations consisted in reducing the monthly expenditure: he pulled down and sold the steam-engine, which was being driven at a cost of $300 a month; in its place he erected a powerful water-wheel, dropped the lift again to the 40 fms., forked the mine, put up 18 heads of stamps, reconstructed the jigging machinery, arranged the crushers to the new water-power, and thus set the surface works in a fair shape to return the ore, when he could get it. They now went below, and for a period of two years were incessantly engaged in clearing out the old runs, timbering old levels, securing ground, and generally making good damages caused by the mine having been full of water. As soon as the mine commenced to throw up lode stuff, it was found necessary to increase the power, as much of the stuff was very poor. To effect this object, a new 38-feet pumping water-wheel, 12-feet breast, was constructed, and placed 1300 feet below the other wheel, and connected by means of flat rods with the engine-shaft. The water in the mine at present is kept by an 8-inch working engine, 4-feet stroke, and 12 strokes per minute; but that to the new wheel is provided with a 12-inch lift; this is intended for an entire new engine-shaft, to be sunk from grass. This new water-wheel and its connectors has only recently been completed, and not yet set in motion: it is to be connected for a time with the old pitwork; the old water-wheel will be then entirely used for dressing purposes.

The mine is situate under the southern slope of a small mountain, of about 700 feet high, composed of gneiss and mica slate rock, the valley or plain below is entirely red sandstone and conglomerate. From the mountain sides are found numerous small veins running into the valley, some of them may be called good lodes,—in fact, they are so, for they have regular walls; one of them is 3 feet thick, and composed of black oxide of iron and manganese, stones of yellow ore, interspersed occasionally with spots of purple copper; they are all more or less composed of carbonate of lime, felspar, flookan, mundic, and yellow copper pyrites, peach, and capel: all these small veins are at right angles to, or caunters with, the main lode.

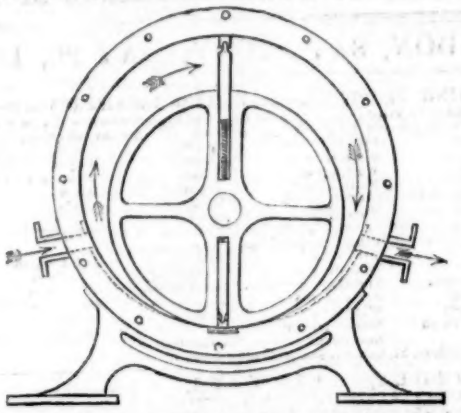
The main lode appears to run parallel with the range of the mountain, which is about 35° north-east; at those parts where it can be examined, it averages about 80 ft. thick, 22 ft. of which is composed of micaceous and felspathic flookan, and 68 ft. of black and grey gneiss, mica slate, and black shiny shale; it has a well-defined wall on this side, dipping at an angle of about 50°; on the flookan side it is overlaid by the sandstone, the flookan part of the lode is widening as it goes down. The engine-shaft is sunk entirely in the sandstone, but at the 40 fm. level it has just intersected the lode on the flookan side. The question at issue now is,—Is it a lode, or is it a mere bunch—a deposit? I am of opinion it is a lode of great magnitude; and the reason why it has made so rich at so shallow a depth is, that the small lodes and branches running from the mountain directly into the flookan have, by infiltration, deposited their mineral products against its side, the flookan itself, being impervious to water, or nearly so, caused the mineral water to percolate through the more porous parts of the lode; in fact, that is quite evident, for where a run of black gneiss, which is very hard, crosses and forms an intersection with the flookan, it invariably carries a rich leader of ore; again, the black gneiss is generally bounded by the grey gneiss, or soft mica-slate, both of which are absorbents, and are, consequently, highly mineralised for a considerable distance from the branch. The stratum of the solid part of the lode is very irregular, the dip and bearings are at every conceivable angle, yet in the veins that traverse it there is an average parallelism perceptible, although at first sight everything seems confused. But what to me, and, perhaps, to every one else who visits this mine from England, will appear to be a most remarkable geological phenomenon is, that in the very centre of the lode are masses of granite—solid quartzose rock, not mere boulders, but rocks 50 ft. long, 40 ft. thick, and 80 ft. deep, in a kind of diamond shape, with their apex pointed downwards. Against these rocks are generally found a vein of solid ore, and the rock itself for 2 ft. in carries thin films of vitreous copper, very rich indeed. Where the black gneiss approaches these granite rocks, there is found a rich mineral channel of ore-bearing ground; this ore is of the bell-metal and purple kind, and produces about 65 per cent. for copper. The compact gneiss, or, as I have here, as a mark of distinction, called it the black gneiss, is similar in texture to grauwacke; there is often ranging with this bands of stripy gneiss, which is composed of alternate layers of gneiss and quartz; the stratum is mostly vertical. Near this there is found a joint or slide, and then against it, in an adverse line of stratum, is found the common mica-slate; here is always found, if the line of cleavage is opposed to the line of main lode, a rich vein of solid ore; hence I infer that the minerals in solution, percolating through a softer medium, are arrested, and deposited in the crevices and against the sides of the harder or more impervious rocks. Now, as regards the flookan itself, to a certain extent it may be said to be non-absorbent, but it is not wholly so, for I find that it contains runs of a false flookan, or, in other words, a shaly micaceous clay; this is found to be very metalliferous. During my stay at the mine, several samples were tried from various parts of the flookan, and they gave an average of 3½ per cent. of ore, and the produce of the ore gave 30 per cent. for copper. From the mica-slate in the vicinity of the black shale, a good many vans were made, the average was over 5 per cent. for ore, with a produce of 50 per cent. for copper. Through the whole lode, which, as I have said before, is over 80 ft. wide, the ore is finely disseminated; it is good stamps' work, and will amply repay the returning cost. Where the veins and droppers occur—and they are not far apart—the ore is solid, from one to 5 in. thick; where vughs occur the ore is very rich. By this next steamer, I have sent a box of specimens; they consist of yellow sulphuret, purple ore, vitreous ore, copper crystals, or copper glance. The yellow ore, I think, will be found on assay to produce from 15 to 25 per cent.; the variegated, or brown bell-metal ore, 45 per cent.; and the vitreous from 35 to 75 per cent. for metallic copper. To some of our old mining friends it may appear somewhat strange, when they see these fine samples, that the mine is not more vigorously prosecuted; and they will be, perhaps, more astonished, that during the past two months six piekmen, above the 30 fm. level, broke and sent to grass nearly 45 tons of copper ore, of the kind I intend sending; that the crop ore from the jigging hutches produced 41 per cent., and the slimes from the trunking machines and buddles 18 per cent., making an average sampling of 29½ per cent.; and yet this very mine, which has produced this ore, has been condemned over and over again as a mere deposit, and not worth working. What is the cause? you will say. Why, nothing more than that the American mining community know nothing about mining. If they can find a sett somewhere down in North or South Carolina, Georgia, Virginia, or Tennessee, that produces rich specimens on the surface, away they go, and create a great noise about the immense wealth of their southern mines, but very little is heard about the monthly return, rich as ever they may be. Now, they have finer mineral properties within four hours' ride of New York. And what can be a more convincing proof; here, at the old slighted Bristol Mine, there is ore ground enough in sight, without sinking a single fathom, to profitably employ 100 hands for five years to come, besides having three known lodes in reserve that have never been worked upon at all. I look upon this mine in no other light than an Australian Burra Burra, or an English Devon Consols. However, the management is now in good hands, and great results in due course of time may be expected. I think it probable that, in the course of the summer, I shall be able to give you a more detailed description of this very interesting property; at present, my views are somewhat cursory, yet, as far as they go, they are substantially correct.

During my sojourn in this part of the state of Connecticut, I have had opportunities of inspecting many mining setts. The Goodwin Mine, belonging to the Hartford Mining Company, is one of considerable promise; they have sunk 10 fathoms in very congenial strata, and driven a cross-cut, and intersected a lode of good promise: it is a flookan lode, and carries ore. The country is very similar to the Old Bristol Mine. They are preparing for the erection of an engine: it is managed by Captain Taylor from Cornwall. The Chatham Cobalt and Nickel Mine holds out very excellent promises of becoming a good dividend-paying mine, if the company do not incur too heavy expenses in its development. The Plymouth Copper Mine and the Plymouth Lead Mines are publicly noticed, both of which are very small workings. Barnum's Mine, in Litchfield county, which was suspended some time since, is about to resume operations under a New York Company, headed by this celebrated caterer of public amusements. I have been over the sett, and find several very promising lodes; they mostly carry copper pyrites, and they are rich in gold; but whether they will pay for working, with miners at 10*l.* a month, and surface labourers at 5*l.* 5s., is a matter for consideration. In concluding this article on the Old Bristol Mine, I will venture thus far to say, that if the proprietors would only expend 8000*l.* in machinery, and opening up the reserves of ore ground, they would possess a mine surpassing every one in the Northern United States.

C. S. RICHARDSON.

PARSEY'S REVOLVING OR CENTRIFUGAL STEAM-ENGINE.

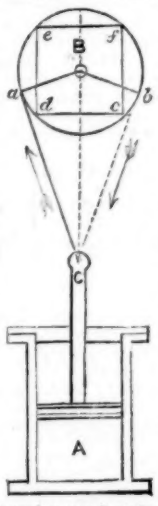
This invention effects the mechanical desideratum of circular motion—it belongs to the class of rotatory engines; but having no overhang, dead point, or back pressure, is, therefore, not subject to the same objections as have caused them to be regarded as less useful than other steam-engines. The construction consists of an outer cylinder, bored perfectly circular, within which is placed a revolving cylinder, the



fixed axle, or shaft, of which is mounted in bearings in the end covers of the external cylinder. The revolving cylinder is made of the same length as the interior of the outer one, but of a considerably less diameter, constantly touching one side of the outer cylinder, throughout the whole of its length, leaving a steam way between them, of a crescent or lune shape. The revolving cylinder is furnished with flyers or paddles, each extending along the whole length, fitting into slots or recesses cut into the cylinder, so that they may project in a right line from the axis. Each slot is cut of a sufficient depth to receive a flyer when pressed down into it, and a spiral spring, by which it may again be forced out. When only two of these slots are cut upon opposite sides (as in the illustration), *orifices* may be made through the boss and shaft, so that the springs may pass through them from the bottom of one to the bottom of the opposite flyer, with loose rods entering holes in the bottom of the flyers, to keep the expansion and contraction of the spring direct.

Upon the outer edge or end of each sliding flyer is placed a self-adjusting head-piece, exactly fitting the interior curvature of the outer cylinder throughout its surface, forming a secure contact and giving easy action to the flyers. When the inner cylinder revolves the flyers will be wholly pressed into their slots, when they are brought round to that part of the revolution at which the inner cylinder comes in contact with the outer one; but as the revolution proceeds, a flyer thus depressed will be gradually elevated by the spring, until it reaches its greatest elevation in the crescent-shaped space. Provision is made for preventing the steam from passing the point where the cylinders touch, but practice shows it not to be absolutely necessary. The ends of the inner cylinder and flyers, and also the interior faces of the end covers, are ground accurately, so that the inner one may revolve freely, but with its ends in contact with the covers, so as to prevent the passage of the steam, which is repelled, in this case, by the centrifugal force. One cover is adjusted accurately, and secured by bolts and nuts in the usual way; the other cover is accurately adjusted with set screws, and the joint between the flanges made steam tight by a metal set strap or hoop, with packing under it all round. There is no packing inside, but metal to metal in every part. Slots, or recesses, are cut upwards and downwards from the inlet and outlet ports, so that the steam takes one flyer before the other begins to blow off (lap but no lead wanted), through which there is no dead point or back action; and as the fittings are uniform, the engine may be made to be reversed at pleasure. Free rotatory motion being thus given to the shaft, the cylinder and its fittings may be elongated to any reasonable extent, and that shaft may be connected with any machinery or apparatus to which it may be required to give motion. Any speed, within that of the velocity of the steam used, may be attained with the power of the engine direct upon the shaft, without the loss of friction and diminution of power from accelerating gear.

By this compact construction of engine, a perfectly free and unimpeded velocity is obtained, with advantages from leverage on the flyers and the direct force of the steam at every point of the revolution, and are peculiarly adapted for driving paddle, screw, or any other shafting. They are not liable to derangement, as the parts are few and all metal, nor to further wear than must attend the best kind of machinery. Increase of the diameters of the cylinders increases the leverage of the flyers, and the increased distance of the travel of the steam around the circumference (while the piston goes up and down only) as many times as the shaft revolves, gives one-third increased velocity to the calculation; and that more available power is obtained by these engines than by double-acting or reciprocating engines, may be seen by the following diagram:

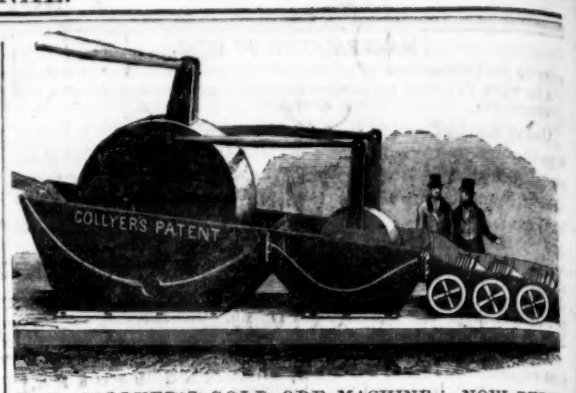


A, represents the cylinder of a reciprocating engine; B, the circle described by a crank of the diameter of the stroke of the piston. The crank pin has a continuous but unequal circular motion. The piston and its connecting rod, to produce this motion, has to rise and fall in opposite directions in the cylinder each revolution of the crank. The connecting rod, C, thrusts and pulls in the direction of the arrows, but neither thrusts nor pulls in the direction of the circle when parallel with the crank, having only its fullest power at the two points, *a*, *b*, or when it is at right angles to the crank and tangential to the circle. In all other relations to each other, the power of pulling and pushing is graduated from maximum to nil and from nil to maximum twice in each revolution. Next, the distances travelled by the piston and the crank are as 2 to 3. The velocity of the crank cannot exceed the velocity of the piston, consequently there is a loss of one-third in velocity or power in equal circular motion, as the intensity of pressure on the piston is distributed over one-third greater distance than the piston travels up and down. Again, the power of the piston rod mainly lies between the two points of the vertical parallel sides, *d*, *e*, *f*, *c*, of the square described in the circle. Between the two points, *e f*, *c d*, of the horizontal lines of the inscribed square, the force is nearly *lateral*, and very inferior to the pull and push of the other sides of the square, which with the crank having to travel over the arc, *d c*, will the piston only advances the height of the segment of the arch, and the same on the other side, *f e*, of the square: such conflicting actions abstract largely from the effective duty of an engine. In addition to which, through the necessary lead of the slide, the velocity of the piston is checked by the opposing steam, has to change its direction, and recover its velocity at those two worst or dead points at which the connecting rod neither pulls nor pushes the crank forward: thus the velocity of a piston that takes 30 strokes is checked 60 times in a minute, and the intensity of the power has to be used to start it again as often, and that, too, at the two worst points of the revolution of the crank, altogether absorbing a very considerable quantity of the usefulness of steam-power.

On comparing the quantity of steam that passes through the cylinder at a given pressure, and through a revolving engine of equal horse power and equal number of revolutions of the shaft of the one and of the crank of the other, the proportion is about 25 per cent. in favour of the circular motion, as the contents of the lunar space is in that ratio to the contents of the piston cylinder each revolution. If an increase of velocity be resorted to to obtain an increase of power in the engine, the increased expenditure of steam will afford no argument to the disadvantage of circular motion, as an equivalent advantage will be gained by the extra power, without any increase of cost for another more expensive engine; for, by providing adequate strength, a revolving engine of a given size may be made to produce a double or triple power, according to the pressure of the steam made use of.

The motion of the number of parts, and the friction of them in reciprocating engines, which must be overcome and taken from the effective working duty of a machine, are reduced to a practical minimum in a centrifugal engine. The mechanical accomplishment of free circular motion cannot fail to be appreciated, and the inventor rewarded for his skill and practical ingenuity, by the manufacturing community of this great commercial country.

RAISING SUNKEN VESSELS, AND PREVENTION FROM SINKING.—The numerous catastrophes which annually occur on our coasts from high winds and storms, accompanied by an awful destruction of human life, and the loss of an immense amount of property, render any scientific and legitimate plan for counteracting these evils of first-rate commercial importance. Many plans for these purposes have been patented during the past half century, but not one of them appears to have been successfully carried out. Such failures we suppose must have arisen from bad management in establishing the companies, or want of confidence on the part of capitalists, as certainly some of them appear to have possessed all the elements of mechanical success. We have, however, now to notice a system patented by Mr. John Trestrail, of the mechanical correctness of which we have no doubt, and which is exemplified every afternoon and evening by lectures delivered by Mr. Johns, and illustrated by experiment on the minature lake, in the Polytechnic Institution. The patentee employs metal caissons having at their upper extremities air-tight chambers, in which are placed the charges of combustibles, consisting of gunpowder mixed with certain ingredients, to render the combustion slow, and fitted with valves, communicating with the interior. These caissons being filled with water, admitted through valves at their lower extremities, sink by their own specific gravity to divers, who secure them to chains or cables passed round the sunken vessel. A sharp blow is then struck on a projecting knob outside the combustible department, which explodes a percussion preparation, fires the gunpowder, and as the gases are evolved they expel the water through the lower valve, and each caisson becomes possessed of great buoyant power, the combination of 20 or 30 of them raising the vessel to surface. The patentee also proposes to generate gas by the decomposition of water by zinc and sulphuric acid. This is termed "exterior ascension;" another plan, by employing air-tight canvass bags inside the vessel, is termed "internal ascension." The patentee's plan for preventing vessels from sinking is to place vulcanised India rubber bags, confined in suitable boxes under the deck beams when danger presents itself; they are to be inflated by suitable gas generators, always at hand, care being taken in building that that the decks are sufficiently strong to bear the upward pressure.



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MANUFACTURED BY

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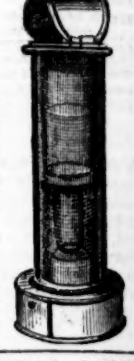

The great obstacle with which the working miner has had to contend in the use of the ordinary safety-lamp is its small amount of illuminative power, by which his work is much curtailed in quantity. The great desideratum of an abundance of illuminative power, combined with safety, is now secured by this patent, in which, by the employment of glass internal cylinders, and metallic gauze of silvery whiteness, a light far superior to a naked candle is obtained; and there is no inducement to the men to remove the tops of the lamps.

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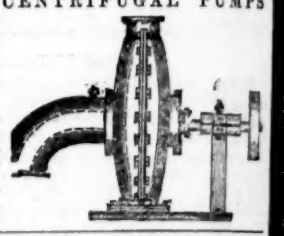
GWYNNE'S PATENT CENTRIFUGAL PUMPS



Contractors, Builders, Engineers, Brewers, Paper Makers, Chemists, Manufacturers, Local Boards of Health, Proprietors of Low Lands, and all engaged in RAISING WATER or OTHER LIQUIDS (hot or cold), will find it to their INTEREST to USE these PUMPS.

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[*May* 20, 1854.